PROJECT FACT SHEET

CONTRACT TITLE: Improved Efficiency of Miscible CO2 Floods and Enhanced Prospects for CO2 Flooding Heterogeneous Reservoirs.

DATE REVIEWED: 03/01/1995 **DATE REVISED:** 03/01/1995

OBJECTIVE: The objective of this work will consist of an experimental research effort aimed at improving the effectiveness of CO2 flooding in heterogeneous reservoirs. The intent is to investigate new concepts that can be applied by field operators within the next two to five years. The proposed activities will consist of experimental research in three closely related areas: 1) further exploration of the applicability of selective mobility reduction (SMR) in the use of foam flooding; 2) the possibility of higher economic viability of floods at slightly reduced CO2 injection pressures, and 3) taking advantage of gravitational forces during low IFT, CO2 flooding in tight, vertically fractured reservoirs.

ID NUMBER: DE-AC22-94BC14977

B & R CODE: AC1510100

CONTRACT PERFORMANCE PERIOD:
04/18/1994 to 04/17/1997
PROGRAM: Supporting Research
RESEARCH AREA: Extraction Research

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SCHEDULED MILESTONES:

TASK 1 - CO2-Foams for Selective Mobility Reduction in Heterogeneous Reservoirs	04/97
TASK 2 - Reduction of the Amount of CO2 Required in CO2 Floods	04/97
TASK 3 - Low IFT Mechanisms with Applications to Miscible CO2 Flooding in Fractured Reservoirs	04/97
TASK 4 - Technology Transfer	04/97

FUNDING (1000'S)	DOE	OTHER	CONTRACTOR	TOTAL
PRIOR FISCAL YRS	320	0	0	320
FISCAL YR 1995	324	0	0	324
FUTURE FUNDS	330	0	0	330
TOTAL EST'D FUNDS	974	0	0	974

PROJECT DESCRIPTION: The overall goal of this project is to improve the efficiency of miscible CO2 floods and enhance the prospects for flooding heterogeneous reservoirs. This objective will be accomplished by extending ongoing experimental research in three areas: 1) foams for selective mobility control in heterogeneous reservoirs, 2) reduction of the amount of CO2 required in CO2 floods, and 3) miscible CO2 flooding in fractured reservoirs.

PRESENT STATUS: The project is in the first year (initiated 4-14-94).

ACCOMPLISHMENTS: TASK 1 - Defined our needs for a particular type of heterogeneous reservoir core to be used in our study of Selective Mobility Reduction (SMR). Made tentative designs of the special core holder that we will fabricate, to make possible the simultaneous measurement of mobility in two parallel halves of core plugs in which two permeability zones are in capillary contact. Testing the permeability distribution in rock samples. We have requested from oil companies whole core samples from reservoirs, from which we can cut samples for definitive experiments on Selective Mobility Reduction.

TASK 2 - Completed a swelling study and miscibility determination for one West Texas crude and a continuous phase equilibrium test for another West Texas crude. These crudes will be used in future tests. Incorporated a CO2-foaming feature in two models: MASTER (Miscible Applied Simulation Techniques for Energy Recovery), obtained from the Department of Energy and UTCOMP, provided by the University of Texas at Austin. We are currently running tests on a three-dimensional quarter of a five-spot pattern to assess the CO2-foam feature's sensitivity and adequacy. Developed several algorithms to improve equations of state predictions of fluid phase behavior. One algorithm improves the solution convergence in critical and three phase regions, and another provides a rapid and accurate means of developing fluid packages for phase behavior models when only limited experimental data are available.

TASK 3 - Analyzed the ability of flash calculations to estimate liquid and vapor densities of multicomponent mixtures, which in turn, are used to calculate IFT's by the Parachor Method. Completed an exhaustive literature survey of all measured IFT's at near miscible conditions for CO2/oil, N2/oil, and gas condensate systems. Computer code has been developed which combines flash routines with Parachor routines. We have used this program to predict all the aforementioned published measurements of IFT's. There has been speculation that IFT's are poorly predicted at near miscible conditions. We have shown that, in general, the Parachor Method is a robust technique for prediction of low IFT's for many simple systems. A pendant drop apparatus has been designed for measuring surface and interfacial tensions for oil/water, and gas/oil systems under reservoir conditions. The system is currently being constructed.

BACKGROUND: Because of the large quantities of oil unrecoverable in fractured reservoirs, new concepts are being considered for these reservoirs that have the potential of recovering huge volumes of oil currently thought unrecoverable by the industry. These new concepts demonstrate the need for research into improvements in CO2 flooding heterogeneous reservoirs so that domestic oil recovery from these reservoirs can be maximized and premature abandonment of potentially productive wells by EOR can be avoided.

New concepts are being investigated that could provide a more favorable response from the use of foam for achieving mobility control in CO2 floods, the possibility of obtaining good oil recovery efficiency by using less CO2 than is commonly practiced in field operations, and taking advantage of gravity drainage and imbibition in CO2 flooding vertically fractured reservoirs.